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After the discussion of the vertebral column, Jækel makes some remarks on the ribs, limb-skeleton and the dermal covering, and concludes his paper with a short summary of his results. I hope that Jækel in his final monograph on *Archegosaurus* will give up the absolutely unfounded opinion of the homology of the intercentrum of *Archegosaurus* with the centra of the higher Vertebrata.—G. B.

Reconstruction of *Phenacodus primævus*, the most Primitive Ungulate.¹³—This paper was accompanied by the re-mounted skeleton of *Phenacodus* and a wax model executed by Charles Knight. As originally mounted in Professor Cope's laboratory, the famous skeleton of *Phenacodus primævus* conveyed a very imperfect impression of its actual form and proportions. Several serious errors were committed by the restorer, the most important of which was the implanting of two of the cervical vertebræ in the tail. The author, therefore, considered it advisable to completely re-mount the animal, and this has been done by Mr. Adam Hermann and Mr. Martin, of the American Museum, at an expenditure of five months time. The animal is placed as nearly as possible in a natural position. It shows that the feet were not plantigrade, or soled upon the ground, but digitigrade, as in the tapir. The body is characterized by the great convexity of the back, characteristic of the Carnivora and of all the early ungulates. A further unguiculate feature is the great development of the hind quarters and of the tail. The disproportion between the hind and the fore quarters is heightened by the extremely small size of the head, containing a brain which was about the size of that of the opossum, as fully described by Cope.—H. F. OSBORN.

BOTANY.

Observations on the Distribution of Plants Along Shore at Lake of the Woods.¹—Professor MacMillan's paper upon the vegetation of the shores at the Lake of the Woods is the most important contribution to American phytogeography since the *Metaspermæ* of the Minnesota Valley of the same author. In this paper, as in the latter work, the elements of the flora have been determined with almost

¹³ Read before the British Association at Toronto.

¹ MacMillan, Conway: Observations on the Distribution of Plants along Shore at Lake of the Woods. Minnesota Botanical Studies, I, 949, 1897.

exhaustive minuteness, and it is not too much to say that, for a large portion of the two regions in which this territory falls, Professor MacMillan's work upon the floral elements will be found to be substantially final. But in the present paper, the author has done much more. He has given a sketch of the shore and beach vegetation from the standpoint of ecology, and a résumé of the formations which it presents. Although several papers of minor importance have dealt with certain aspects of some ecological and formational problems, Professor MacMillan has undoubted right to the honor of being the first in the field in this country, if not indeed in the English tongue, with an account of extended research in these lines. Pointing this out with pardonable pride, he has offered his contribution as an incentive to others to undertake and to continue a sort of botanical work which stands in need of many investigators. The author is emphatically a man of ideas, as he has demonstrated in more than one department, and his contribution at this time, when investigation in this country is but beginning, is welcome and opportune.

At the outset, it should be noted that the author's standpoint is purely ecological, not phytogeographical. He is concerned solely with the physical environment of the plants of the locality, not with the biological environment that in so many instances proves of no less moment. It is not easy to make distinctions of this sort, since they depend largely upon the point of view of each writer. But, in general, the phytogeographer looks primarily at the floral covering as such. He studies, analyzes, and traces the development of the floral covering as a whole, and in restricted areas. For this purpose, he brings to bear his knowledge of the physical and biological environment and of the plants themselves as well, their morphological adaptations as shown in primary and secondary biological characters, modifications for purposes of duration, seed-production, dissemination and so forth. But the ecological phytogeographers appear to restrict themselves for the most part to the investigation of certain aspects of the relation of the floral covering to its physical environment. This investigation is, without doubt, of great importance, but the limitations of such a procedure appear clearly in the paper under review.

The discussion of the physical conditions prevailing upon the shores at Lake of the Woods is a masterpiece of analysis. Everything has been taken into account, and every modification which might affect the floral covering has been investigated and pointed out. This analysis has been made not only with reference to the more important factors—water-content, illumination and temperature, but also with reference

to all minor influences. That portion of the paper dealing with the physical conditions of the locality is the most important, since it suggests methods of procedure for other regions. It deserves study at the hands of all who are engaged with similar problems. But, at the same time, it must be said that for most purposes the analysis will be found too exhaustive. The perception of the relation of habitat and organism stands at the foundation of phytogeography; yet all of the physical factors are not of equal importance. Plants have more to do than merely to contend against physical conditions; they have to contend with other plants. Individuals contend with each other, vegetation form with vegetation form, floral element with floral element, and formation with formation; a struggle goes on everywhere in the floral covering that forces plants to adapt themselves to strange and even unwelcome environments. The influence of modifications due to this necessity is one that may never be overlooked. Extended investigation of a large territory is required to enable one to measure the relative importance of these factors, but it cannot escape notice that a number of species listed by Professor MacMillan are ruderal species of varied habitat, which may be met with in meadow, clearing, high prairie or sand hill, as well as in the situations where he found them. In fact, it is only by beginning at the other end, by studying the vegetation forms of a region and the accessory characters of this vegetation, and so reaching an understanding of the means by which plants are enabled to take possession of the soil and to maintain themselves there, that one can comprehend the really characteristic and dominant vegetation and arrive at an understanding of formations.

The discussion of the biological factors which determine the vegetative covering of the region, therefore, seems quite inadequate. An analysis of these biological factors made with the same minuteness as that of the physical factors, might not be necessary, and yet it cannot fail to suggest itself to those who have been engaged in the study of like problems in other regions, that the former, in general, is likely to be the much more valuable, if carried beyond a certain point. The physiographical and climatological conditions are undoubtedly of controlling force while vegetation is establishing itself in a new area. Once established, vegetation reacts upon its environment and upon itself, and new forces have to be reckoned with. One would think that a more careful consideration of these and of the influence of vegetation forms and their distribution would have made such phenomena, as the occurrence of *Celastrus* and *Parthenocissus* in the back-strand rather than in the mid-strand (p. 979) much more clear.

It has been pointed out in a previous paper that the formation is a definite phytogeographical concept, determined by its statistic, vegetation forms and habitat groups. The determination, or better, the recognition of a formation is conditioned by the previous analysis of its constituents from these various standpoints. This fact was first appreciated by the Continental phytogeographers, and Drude was the first to carefully elaborate the formations of an entire flora in accordance with this principle. The fundamental nature of his work in this line renders his researches classic, and his conclusions superlatively final, for the present at least. As is well shown in his *Deutschlands Pflanzengeographie*, I, it is necessary to first comprehend the floral covering by a careful analysis of its floristic, vegetation forms and habitat groups, and then by even more careful synthesis, determine the formations thus pointed out. While the floral covering may be truthfully likened to a mosaic in which the various pieces are formations, it is not true that every distinguishable bit of difference is a formation. It must likewise be borne in mind that formations are by no means of fixed and absolute expression: they are at all times more or less plastic, manifesting modification, incipience, decadence, and most intimate relations with other formations.

It is, at present, so common to reproach European botanists, and particularly those upon the Continent, for their disregard of the results of American investigation, that it is odd to be obliged to call attention to American neglect of European research. Yet the article in hand manifests just such a lack of acquaintance with the fundamental contributions of Drude. Drude's concept of the plant formation is undoubtedly to be regarded as the correct one. Measured by this standard, the great number of formations noted for a small area by Professor MacMillan fall in most cases to the rank of facies, or patches, or they are at best only incipient or decadent stages of real formations. The author has committed two serious mistakes in his elaboration of the Lake of the Woods formations: the first is lack of perspective, the second is too minute analysis. It is impossible to delimit formations accurately by studying the floral covering of a restricted area. Such limitation can be done intelligently and well only in a natural vegetation area; except in the rarest cases, in nothing smaller than a vegetation region. A formation must be studied in all its various stations and in its many phases, before final conclusions can be reached concerning its validity. From the lists given, the floral covering in the vicinity of the Lake of the Woods is composed of the most heterogenous elements, which have crowded together in peculiar fashion. Apprecia-

ting this fact, then, such a floral covering could be well comprehended only after the exhaustive study of the formations of the entire vegetation region. Had this been done for the present contribution, many of the so-called formations would have been referred to the real formations of which they are immature or incomplete expressions. As a concrete illustration, all of what Professor MacMillan terms surf-barrier formations are merely isolated facies and patches of certain water-plant formations common throughout the Allegheny and Prairie provinces.

In analysing too carefully, the author has noted everything distinguishable as a formation, a method which serves very well for the mere cataloguing of phytogeographical phenomena, but is one scarcely to be commended as affording a basis for work of much value. Upon many such points, one not familiar with the country studied is incapable of passing judgment, but, in some instances, the mistakes are apparent even to one not conversant with the particular floral covering. Front-strand, mid-strand and back-strand represent merely a more or less radially biologically symmetrical formation, the nucleus of which is found in the back-strand, from which the formation "shades out" toward the lake with accustomed zonation. As for strand pools, the three sorts are merely developmental aspects of one formation. The formation is best represented by the back-strand pool, which is simply the ultimate expression of the water plant formation represented in its earlier stages by mid strand and front-strand pools. Dune pools are likewise to be referred to the same formation. Soil shore formations are not at all peculiar to the Lake of the Woods; they are aspects of formations which occur over a large portion of the continent. Talus formations are such only in rare instances; they are usually incipient formations of very various types. It is perhaps unnecessary to point out further instances of such incorrect analysis. It only remains to remark the similarity between the many lists of species of different formations, and to call attention to the large number of meaningless ruderal and subruderal plants contained in them. Formational statistics to be of value must be arranged with reference to facies, principal species, secondary species, etc., and not in bald lists.

—ROSCOE POUND,
FREDERIC E. CLEMENTS.